DATA & TRENDS – SIDEBAR

Place-based Differences in Life Expectancy

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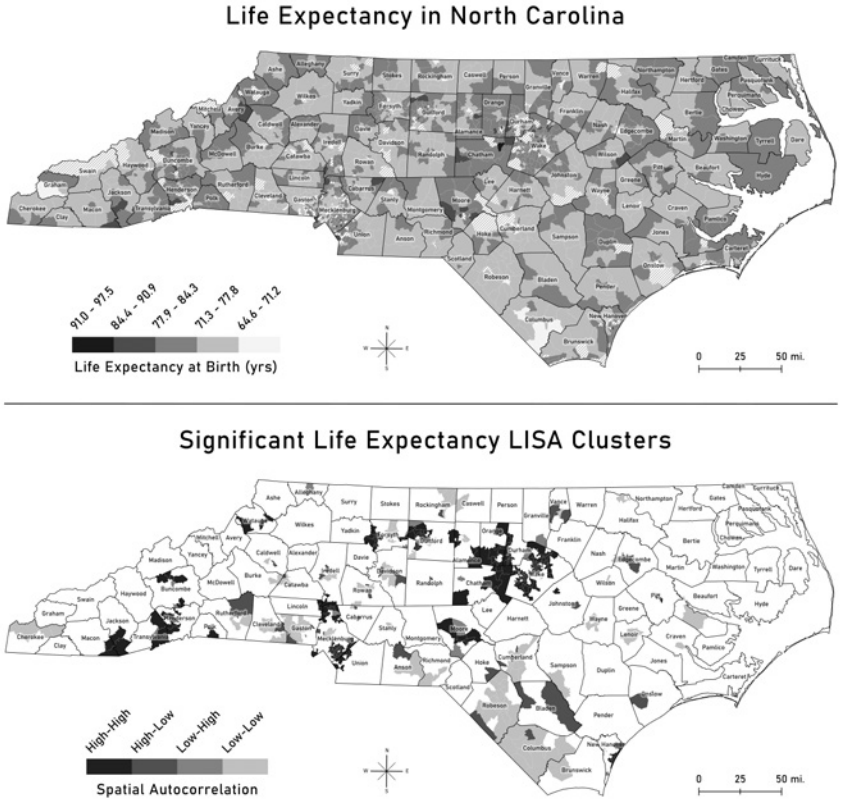
Life expectancy is an important indicator of a population's overall health and can vary significantly depending on underlying health disparities, demographics, and social determinants of health. Moreover, life expectancy is an easily understood indicator for policymakers and the general public that allows direct comparisons across space and time. As of 2019, North Carolina ranked 37th in the nation with an average life expectancy at birth of 77.6 years; however, this average varies significantly across geographic regions [1]. For instance, based on data published by the National Center for Health Statistics (2010–2015), the census tract with the highest life expectancy in the state (97.5 years) is located in Chatham County (Pittsboro, North Carolina). In contrast, Catawba County (Hickory, North Carolina) recorded the lowest life expectancy during that time (64.6 years) (Figure 1). Spatial variation in life expectancy is on the rise, likely exacerbated by the COVID-19 pandemic, opioid use disorder, obesity rates, and lack of health care access [2, 3].

In a previous analysis of North Carolina, relying on a metric that compares the most economically deprived to the most economically privileged populations, we found that spatial measures of income segregation were the most important predictors of life expectancy [4]. Similar to income segregation, the percentage of residents living in poverty or who were unemployed were the main drivers of spatial variation in life expectancy at the census-tract level. Our work aligns with multiple studies indicating people living in economically distressed areas have a lower life expectancy [5]. Racial segregation predicted considerable variation in geographic life expectancy values, but the changes were smaller than income measures [5].

Despite these findings, our results should be interpreted with caution, as policies targeting socioeconomic disparities are complex, and causal relationships are difficult to disentangle.

Rural-urban disparities also exaggerate life expectancy across geographic regions in the United States. James and Cossman (2017) uncovered a distinct rural disadvantage

FIGURE 1.
Life Expectancy at the Census-Tract Level (Top) and Spatial Clustering of Life Expectancy (Bottom) in North Carolina, 2010–2015



Note. 2010–2015 LE across North Carolina census tracts and significant Local Indicator of Spatial Association (LISA) clusters of life expectancy. Data are provided by the US Small-Area Life Expectancy Estimates Project (USALEEP), in partnership with the National Center for Health Statistics, Robert Wood Johnson Foundation, and National Association for Public Health Statistics and Information Systems.
To analyze spatial autocorrelation in life expectancies, the Univariate Local Moran's I statistic—a Local Indicator of Spatial Association (LISA) statistic—was implemented using GeoDa 1.20.0.10. The Local Moran's I statistic identifies significant ($P < .05$) spatial clusters and outliers based on predefined neighborhoods. For this analysis, neighborhoods were defined with first-order Queen contiguity. Tracts without life expectancy data were removed. The results revealed large clusters of high life expectancy (high-high) near the Triangle (Raleigh-Durham, NC), in north and south of Charlotte, and in southwest North Carolina, as well as large clusters of low life expectancy (low-low) in Robeson and Columbus counties in southeast North Carolina and Cleveland and Gaston counties in the Piedmont. Outliers (high-low and low-high) were dispersed throughout North Carolina.
Source. Anselin L, Syabri I, Kho Y. GeoDa: an introduction to spatial data analysis. *Geographical Analysis.* 2006;38(1):5–22. https://doi.org/10.1111/j.0016-7363.2005.00671.x

in which, generally, rural locations with lower income and education levels experienced widening life expectancy disparities [6]. Using coarse measures of rural and urban for North Carolina, we find that rural life expectancy is lower (77.2, SD = 3.22) than urban life expectancy (77.4, SD = 3.57). Unlike more basic rural-urban definitions, rural-urban commuting area (RUCA) codes [7] are standard measures of population density, urbanization levels, and commuting distance used to characterize census tracts and may provide more detailed trends for policy interventions at a sub-county spatial scale. These more detailed measures of rurality across North Carolina show that micropolitan census tracts or those with commuting flows to urban areas (RUCA: 4–6) have the lowest life expectancy (76.3, SD = 3.13), followed by small rural towns (RUCA: 7–9, 77.0, SD = 3.54), while urban areas (RUCA: 1–3, 77.7, SD = 3.59) and isolated rural towns have the highest life expectancy (RUCA 10, 77.7, SD = 3.17). In North Carolina, rural-urban disparities of life expectancy are significantly different for micropolitan versus isolated rural towns and micropolitan versus urban tracts (*P*-value < .01). Further subdivision of RUCA codes highlights life expectancy nuances, with the most urban areas (RUCA: 1) having the highest life expectancy of 77.8 years, followed by the most rural locations (RUCA: 10, 77.7 years; RUCA: 8, 77.4 years), and then less-metropolitan locations (RUCA: 2, 77.1 years). The lowest life expectancy was found in micropolitan locations (RUCA: 4, 75.8 years; RUCA: 7: 76.7 years; RUCA 3, 5, and 6; 76.9 years). Our results highlight the subtle differences across rural measures and the need for further spatial analysis of data trends at a sub-county scale.

Across North Carolina's three physiographic regions, life expectancy is lowest in the Coastal Plain (76.6) and highest in the Blue Ridge (78.1), with significant mean differences (*P*-value < .01) among each region except for Piedmont (77.1) and Blue Ridge (78.1). Metropolitan, micropolitan, and rural segments of the mountains report the highest life expectancy (78.9, 78.2, and 78.1, respectively). These results (2010–2015) contrast with recent findings that show low life expectancy in other areas of Appalachia (1990–2013), particularly due to substance misuse [8]. Our findings highlight the local heterogeneity and explicit place-based differences across a diverse state like North Carolina that are driven by both individual and community-level characteristics.

Inequality in life expectancy spatially over time is an important population health metric to track in order to monitor progress toward achieving a more equitable average lifespan at the local and state level, and to reach goals such as those detailed in "Healthy North Carolina 2030" [9]. Large numbers of communities in North Carolina are being left behind, often in specific micropolitan regions (RUCA: 3–5) or those with high income segregation. These trends may not follow similar patterns at larger spatial scales, and more research is needed at a local level (Figure 1) to identify appropriate focal areas for health interventions and policy targets for evaluating progress. NCM

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References

1. National Center for Health Statistics. U.S. Small-Area Life Expectancy Estimates Project (USALEEP): Life Expectancy Estimates File for North Carolina, 2010-2015. Centers for Disease Control and Prevention website. Last reviewed June 9, 2020. Accessed July 15, 2022. https://www.cdc.gov/nchs/nvss/usaleep/usaleep.html
2. Wang H, Schumacher AE, Levitz CE, Mokdad AH, Murray CJI. Left behind: widening disparities for males and females in US county life expectancy, 1985–2010. *Popul Health Metr.* 2013;11(1):8. https://doi.org/10.1186/1478-7954-11-8
3. Dwyer-Lindgren L, Bertozzi-Villa A, Stubbs RW, et al. US county-level trends in mortality rates for major causes of death, 1980-2014. *JAMA.* 2016;316(22):2385–2401. https://doi.org/10.1001/jama.2016.13645
4. Mitchell JH, Runkle JD, Andersen LM, Shay E, Sugg MM. Inequalities in life expectancy across North Carolina: a spatial analysis of the social determinants of health and the index of concentration at extremes. *Fam Community Health.* 2022;45(2):77–90. https://doi.org/10.1097/fch.0000000000000318
5. Chetty R, Stepner M, Abraham S, et al. The association between income and life expectancy in the United States, 2001-2014. *JAMA.* 2016;315(16):1750–1766. https://doi.org/10.1001/jama.2016.4226
6. Cossman J, James W, Wolf JK. The differential effects of rural health care access on race-specific mortality. *SSM Popul Health.* 2017;3:618–623. doi: 10.1016/j.ssmph.2017.07.013
7. Economic Research Service. Documentation: 2020 Rural-Urban Commuting Area Codes. U.S. Department of Agriculture website. Published 2020. Accessed July 15, 2022. https://www.ers.usda.gov/data-products/rural-urban-commuting-area-codes/documentation
8. Singh GK, Kogan MD, Slifkin RT. Widening disparities in infant mortality and life expectancy between Appalachia and the rest of the United States, 1990–2013. *Health Aff (Millwood).* 2017;36(8):1423–1432.
9. North Carolina Institute of Medicine and North Carolina Department of Health and Human Services. *Healthy North Carolina 2030: A Path Toward Health.* North Carolina Institute of Medicine; 2020. Published January 2020. Accessed July 15, 2022. https://nciom.org/wp-content/uploads/2020/01/HNC-REPORT-FINAL-Spread2.pd

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